

REMARKS

STATUS OF THE CLAIMS

Claims 1, 3, 5, 9-15, 17-27, 29-40, 42-46, and 48-57 are currently pending.

Claims 2, 4, 6-8, 16, 28, 41, and 47 have been cancelled without prejudice to their assertion in a continuing application.

Claims 1, 3, 5, 9-11, 13, 15, 17-18, 20, 21, 23, 25-27, 29-32, 34-36, 40, 42, 45, 49-51, and 56-57 have been amended.

No new matter has been added.

CLAIM AMENDMENTS

Claim 1 has been amended by incorporating the limitations of cancelled claims 2, 4, 6, and 8. Further, " $\text{Mg}(\text{OR}_1)_{2-n}(\text{R}_1)_n\text{X}_x$ " has been amended to " $\text{Mg}(\text{OR}_2)_{2-n-x}(\text{R}_1)_n\text{X}_x$ ", to correct an obvious error in the formula. Without the amendment, "X" could not be present in the formula, whereas there are several examples in the application where "X" can be present (for example, see pages 10 and 11 of the application as filed). In addition, formula (II) has been amended to read " $\text{Al}(\text{R}_1)_y\text{Y}_{3-y}$ " to clearly define formulas (I) and (II) with respect to one another.

Claims 1, 10, 11, 13, 18, 20, 32, 34-36, 45, and 49-51 have been amended to define the alcohol and alkoxy groups with the variable " R_2 ," in order to remove any potential ambiguity from the claims.

Claims 3, 17, 26, 27, and 42 have been amended in light of the limitations introduced through amendments to Claim 1.

Claims 5 and 29 have been amended for clarity as recommended by the Examiner.

Claim 9 has been amended to further define the compound of formula (II). Support for the amendment can be found in the application as filed on Page 11, Lines 19-30.

Claims 10, 18, and 45 have been amended to remove superfluous references to the variable "x".

Claims 15 and 40 have been amended to replace the word "obtainable" with "obtained" as recommended by the Examiner.

Claim 21 has been amended to limit the claim scope to Ziegler-Natta catalysts containing only Group 4, 5 or 6 metals, which are identified as preferred on page 13, lines 28 to 31, of the published PCT application.

Claim 23 has been amended to correct the formula for titanium tetrachloride.

Claims 25, 56, and 57 have been amended to indicate the steps involved in the claimed process. Support for the amendments can be found in the application as filed on page 19, line 13 - page 20, line 10.

Claims 30 and 31 have been amended to replace the word "in" with "at" as recommended by the Examiner.

1. Rejection of Claims 1-57 Based on 35 U.S.C. § 112, First Paragraph

Claims 1-57 have been rejected for allegedly lacking enablement for group 13 and 14 elements other than aluminum. While the applicants

respectfully disagree, in order to expedite prosecution and the issuance of the application as a patent, they have amended the claims to encompass the preparation of aluminum containing catalyst supports, support-bound catalysts, and processes for their preparations. As a result, the rejection is moot, and the Applicants request that it be withdrawn.

2. Rejection of Claims 21-25 and 52-57 Based on 35 U.S.C. § 112, First Paragraph

Claims 21-25 and 52-57 have been rejected for allegedly lacking enablement for Ziegler-Natta catalysts containing metals other than Group 4 and 5 elements. While the applicants respectfully disagree, in order to expedite prosecution and the issuance of the application as a patent, they have amended the claims to encompass the preparation of support-bound Group 4 and 5 Ziegler-Natta catalysts, and processes for their preparations.

3. Rejection of Claims 1-57 Based on 35 U.S.C. § 112, Second Paragraph

Claims 1-57 have been rejected for allegedly being indefinite for a variety of reasons as specified in the Office Action.

In addition to the present amendments to the claims (*vide supra*), the Applicants note the following with respect to terminology objected to by the examiner.

(a) "adjusting the molar ratio"

Due to the new claim wording of claim 1, it is now even clearer that the solidified catalyst component is washed with a wash solution until the molar ratio of Al to Mg has a specific value.

As stated on page 7 of the application as filed, the ratio can be monitored between the washings, for example, by analyzing the support samples via techniques common in the art. Therefore, the phrase is definite because one skilled in the art would understand the meaning of the rejected phrase. As such, reconsideration and withdrawal of this rejection is requested.

(b) Definition of R₁

The Applicants have amended the claims to differentiate the "R₁" group which is part of the alcohol and dialkoxymagnesium compounds in Claims 1, 10, 11, 13, 18, 20, 32, 34-36, 45, and 49-51, from the "R₁" groups which are a part of the starting dialkyl magnesium and (di)alkylaluminum chloride compounds. Support for the amendment can be found throughout the application as filed. In particular, Page 15, Lines 5-32, and Page 23, Lines 1-19, each illustrating that the alcohol (preferably, 2-ethyl-hexanol) may contain different "R₁" groups from the starting magnesium compound (preferably BOMAG, Page 21, Lines 17-18, (C₄H₉)_{1.5}Mg(C₈H₁₇)_{0.5}), while all falling within the definition of R₁ as a "C₁-C₂₀ hydrocarbyl group".

In light of the previous comments and the present amendments to the claims, the Applicants submit that the claims are definite, and respectfully request withdrawal of the rejection.

4. Rejection of Claims 1-57 Based on 35 U.S.C. § 102(b) in view of U.S. Patent 4,496,660 (Gessell et al.)

Claims 1-57 have been rejected for allegedly being anticipated by U.S. Patent 4,496,660 (Gessell et al.). In particular, the Office asserts that the invention as claimed is disclosed in Example 22 and Claims 13 and 21 of Gessell. The Applicants respectfully disagree.

In Example 22, 275 mmol ROH is added to a mixture of 50 mmol $\text{Mg}(\text{Bu})_2$ + 25 mmol $\text{Al}(\text{i-Bu})_3$ (alcohol is used in excess). As a result, 50 mmol $\text{Mg}(\text{OR})_2$ + 25 mmol $\text{Al}(\text{OR})_3$ ("compound A") and 100 mmol ROH (excess) is obtained. The obtained compound A is chlorinated with SiCl_4 (compound B), wherein the OR groups on Mg are replaced by Cl. Some solid material is obtained, which is re-slurried with hexane. During this procedure, ROH is removed. The obtained product contains at least the components MgCl_2 and $\text{Al}(\text{OR})_3$, but there is no disclosure of the support, as is encompassed by the currently pending claims. It is not known what happens during the hexane treatment, for example, whether other components are removed or to what extent.

In contrast to Example 22 in Gessell, the particulate catalyst support of the present invention is prepared in a unique fashion. First, the solution of a magnesium compound is added to the solution of the aluminum compound, whereupon precipitation occurs. The

addition order is of great relevance and importance as the addition of the magnesium to the aluminum leads to the particulate support with the desired morphology. As stated previously, in Example 22 in Gessell, both the magnesium and aluminum compounds are provided in the reaction vessel, and then an alcohol is added (in large excess), followed by dropwise addition of SiCl_4 . Precipitation occurs only upon addition of SiCl_4 , and not before.

Second, according to the present invention, the desired morphology and Mg:Al ratio of the catalyst support are obtained by a controlled washing step. The support is clearly recovered and washed prior to its use as a carrier material for catalyst preparation.

In light of the above arguments and claim amendments, Applicants submit that the currently pending claims are not anticipated by Gessell. Therefore, they respectfully request reconsideration and withdrawal of the 35 U.S.C. § 102(b) rejection based on U.S. Patent 4,496,660.

5. Rejection of Claims 1-57 Based on 35 U.S.C. § 102(b) in view of WO 01/55203 (Garoff et al.)

Claims 1-57 have been rejected for allegedly being anticipated by WO 01/55203 (Garoff et al.) In particular, the Office asserts that the invention as claimed is disclosed in Examples 2, 3, and 6 of Garoff. The Applicants respectfully disagree.

In Examples 2 and 3, Garoff describes a process for the preparation of a catalyst where an aluminum compound (ethyl aluminum

dichloride) is added to the reaction product of a magnesium compound (BOMAG-A) and an alcohol (2-ethyl-hexanol).

However, as previously discussed with respect to Gessell, there are fundamental differences between the process of the present application and the process described in Garoff. In Garoff, the chemicals are added in such an order that a solid support material is never formed by the chemicals themselves. This is done by adding the chlorinating EtAlCl_2 dropwise to the Mg(OR)_2 solution. Addition of reagents in the order of Garoff prevents the situation where Mg(OR)_2 meets an excess of EtAlCl_2 , to initiate precipitation. This can be expressed as:

Present application: Mg(OR)_2 added to EtAlCl_2 -> Precipitation.

Garoff: EtAlCl_2 added to Mg(OR)_2 -> Soluble complex.

Consequently, Garoff (Example 4 and 5) utilizes silica as a support material for the soluble complex to provide a specific morphology to the catalyst (which is not provided in Examples 2 and 3).

In Example 6, no silica support is used, and a soluble complex is created consisting of all the catalyst components using the addition order technique as described above. The liquid catalyst complex solution is added as such directly into the polymerization reactor together with the co-catalyst. As such, no suitable catalyst morphology can be achieved utilizing this technique, and the polymer morphology reflects a corresponding disorder. In practice, it can be expected that the free TiCl_4 reacts with the co-catalyst and

precipitates as TiCl_3 , which, in turn, affects the particle size and the particle size distribution of the polymer.

In contrast, the present application describes a support synthesis that uses the reverse addition order to create an ordered precipitation reaction. By adjusting the wash conditions of the precipitate (see, Table 1 of the application as filed), the reduction power of the support material can be adjusted to a desired level.

Further, Garoff is silent with respect to the adjustment of the molar ratio of Al to Mg and obtaining the desired morphology (particularly via a controlled washing step). In the present application, the support is clearly recovered and washed prior to its use as a carrier material for the catalyst preparation. Garoff does not disclose any washing step to adjust the molar ratio of the particulate support, even in examples 4 and 5 where a carrier (silica) is used.

In view of above arguments and claim amendments, Applicants submit that the currently pending claims are novel. As such, they respectfully request reconsideration and withdrawal of the 35 U.S.C. § 102(b) rejection based on the Garoff reference.

6. Rejection of Claims 1-57 Based on 35 U.S.C. § 103(a) in view of WO 99/55741 (Vereecke et al.)

Claims 1-57 have been rejected for allegedly being obvious in view of WO 99/55741 (Vereecke et al.). In particular, the Office asserts that Vereecke discloses the invention substantially as claimed

on pages 7 - 9 of the application, notably, catalysts A and B. The Office concedes that Vereecke lacks disclosure of the aluminum to magnesium ratio, but nevertheless states that the ratio may be arrived at without undue experimentation. Further, the Office alleges that there was a reasonable expectation of success that one skilled in the art could modify the disclosure of Vereecke to obtain the claimed catalyst support and methods. The Applicants respectfully disagree.

In the present application, the order of addition of the solution of the Mg compound to the solution of the Al compound differentiates the present process from that disclosed in the prior art. This addition order allows for the precipitation of a uniform solid reaction product with a more desirable morphology (see Page 5, Lines 1-5 of the application as filed).

Vereecke, in the Examples of Catalysts A and B utilize the reverse sequence of addition with respect to the present application, i.e., the addition of the aluminum compound to the magnesium compound. In particular, it can be learned from page 5, second paragraph of Vereecke that if one were to reverse the steps of their method (i.e. the method of the present application; emphasis added),

*A **catalyst of poor morphology is obtained** if the mixing is performed without appropriate control, for example where a solution of the dialkyl magnesium compound is added to excess chlorinating agent (**i.e. in the reverse order, as is encompassed by the pending claims**).*

Vereecke does not make the presently claimed invention obvious because it teaches away from the present invention. See, for example,

Catalyst C3 in Vereecke (end of Page 10 to top of page 11) where the reverse steps are utilized (i.e. a solution of the magnesium compound is added to a solution of the aluminum compound; emphasis added),

This example shows that this process is not suitable for the production of a catalyst with a narrow particle size distribution.

In view of the disclosure of Vereecke, one skilled in the art would not consider, or have an expectation of success in, modifying the procedure Vereecke to produce the present invention. Based on the teaching of Vereecke, the person of ordinary skill in the art would expect that a catalyst with poor morphology would be obtained.

Further, Vereecke does not utilize a solution of a dialkoxy magnesium compound, rather only using dialkylmagnesium compounds. While dialkoxy magnesium compounds may be formed *in situ* upon addition of the dialkyl magnesium compounds to the alkoxyaluminum chlorides in the presence of excess alcohol, there is no teaching or suggestion in Vereecke to use a pre-formed dialkoxymagnesium compound, nor would there necessarily be an expectation of success in modifying the method of Vereecke (*vide supra*).

The present invention further provides a washing step for the precipitated solid support prior to its use as a carrier material. The washing step improves the properties of the support, and subsequently produced polymerization catalyst (see page 6, Line 32 through page 7, Line 78; and Tables 3 & 4). Vereecke is silent with respect to a washing the particulate support material as a means to

adjust and control the molar ratio of Mg:Al therein. Vereecke does disclose a washing step utilizing heptane to "clean" the support from unreacted components, unwanted reducing power (*vide infra*) of the support material, and unwanted side products (end of page 5 through top of page 6; Claim 1). One skilled in the art would not be motivated by Vereecke to consider the use of a washing step to adjust the Mg:Al ratio within the support material, as there is no explicit teaching, nor a suggestion of how to achieve such a result.

Finally, the present invention provides a support material that is capable of substantially reducing Ti, and as such is a distinctly different product with unexpected properties when compared to the products disclosed in Vereecke. As can be seen in Table 3 on page 26 of the application as filed, about 50% of the Ti is reduced without the addition of an additional reducing material, simply by contacting TiCl_4 with the support material. This "internal" reduction of the Ti *significantly improves the performance of the catalyst, as evidenced by a substantially higher catalytic activity of 319 kg PE/g Ti for the catalyst of the present invention versus 60 - 190 kg PE/g Ti for the various catalysts in Vereecke.*

In light of the above arguments and the claim amendments, Applicants submit that the currently pending claims are not obvious. Therefore, reconsideration and withdrawal of the rejection based on 35 U.S.C. § 103(a) is respectfully requested.

CONCLUSION

Applicants respectfully contend that all requirements of patentability have been met. Allowance of the claims and passage of the case to issue are therefore respectfully solicited.

Should the Examiner believe a discussion of this matter would be helpful, he is invited to telephone the undersigned at (312) 913-2114.

Respectfully submitted,

Date: September 13, 2006

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